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A METHOD OF EVALUATING THE RELATIVE EFFICIENCY OF INSECTICIDES USED IN FIELD TESTS AGAINST TOBACCO HORNWORMS

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INTRODUCTION

The evaluation of treatments for the control of the tobacco hornworm, performed under field conditions, has been based in the past upon the "percent of kill", or upon counts of the total larvae present during the period of the experiment and of the larvae remaining at the conclusion of the experiment, or upon counts of only those larvae remaining at the end of the period. Each of these methods is open to certain criticisms. A method used for the first time this past season appears to have distinct advantages over those used previously and may be applicable to other insect-control problems.

NECESSITY FOR A NEW METHOD

It has been found that the quantity of tobacco leaf consumed by the different instars of the hornworm varies greatly and increases tremendously with each successive instar. Below are shown the relative quantities of shade-grown tobacco leaf consumed by each instar.

Instar	Square inches
First	0.84
Second	1.50
Third	5.16
Fourth	27.19
Fifth	300.99
Total	335.68

From this it is seen that the third instar consumes more than the total quantity of leaf surface eaten by the two previous instars together, that the fourth consumes five times as much as the third, and that the fifth consumes eleven times as much as the fourth. The twelve commercially valuable leaves on a shade-grown tobacco plant usually attacked by hornworms represent an average total of 962 square inches of leaf surface. From the standpoint of the prevention of crop damage, therefore, it is obvious that some method which would differentiate between the effect of the treatments on the younger instars and its effect on the older ones is essential.

The evaluation of poison treatments from the count of total larvae, a method frequently used in experiments in hornworm control, is considered unsatisfactory for several reasons. A count of total larvae is the expression of the results of two main factors, viz., the treatment factor and the distribution factor. It appears probable that in this total-count method the effect of the factor of unequal distribution cannot be removed without recourse to a very considerable number of replications. A count of total larvae is also open to the criticism that it includes many small-sized individuals that have not come under the influence of the treatments for any appreciable length of time. The main criticism of the method of counting all larvae, however, is the fact that it does not differentiate between the sizes of the larvae although, as has been shown, the hornworm larvae that have passed beyond the second instar are potentially a much greater menace to the crop than are the smaller individuals. In cases of heavy infestation, such as are frequently encountered, the foliage on unpoisoned plots is often almost entirely consumed before the end of the growing season. It is evident that the efficiency of a treatment should be based upon its effect on those stages of the insect capable of causing the greatest damage and not upon the mere number of insects present.

EXPLANATION OF THE METHOD

During the first three weeks of the experimental period, weekly examinations were made to determine the number of living larvae present on a representative number of plants in each plot, although insecticides were not applied during this period. Data from these first three examinations indicated the trend of the infestation and the proper time for applying the first series of insecticide treatments.

After the insecticides had been applied, the fourth examination and the weekly examinations made thereafter recorded not only the total number of larvae present on the samples examined, but also the number of larvae that had passed beyond the second instar, as distinguished from the number of individuals of smaller size. First-instar larvae that had not yet fed at the time of observation were excluded from the counts.

At the conclusion of the experiment the ratio of the larvae of the third and later instars to the total larvae of all instars was computed for each plot treatment. These ratios were considered to be a measure of the relative efficiency of the respective treatments and were used for comparison, the lower the ratio the more efficient the treatment. Data obtained from five hornworm-control treatments during one day, with three replications of each treatment, are given in the following table as an example of the application of the method. In practice the ratios computed from a series of approximately seven weekly examinations, each figured as in the example, were used for the final evaluation and served as a more accurate measure of efficiency. The data were further analyzed by the usual statistical methods.

EXAMPLE

Data on the efficiency of insecticides for hornworm control obtained in Robinson field on June 6, 1935

Replication no.	1 Lead arsenate and lime, 5-3		2 Paris green and lime, 1-4		3 Paris green and lime, 1-6	
	Total larvae[1]	Larvae of third and later instars	Total larvae	Larvae of third and later instars	Total larvae	Larvae of third and later instars
1	16	2	25	1	17	4
2	4	0	14	1	18	0
3	13	1	17	2	28	1
Total	33	3	56	4	63	5
Ratio	0.091		0.071		0.079	

Replication no.	4 Derris, sulphur, and clay, 1-1-2		5 Phenothiazine diluted 1-10	
	Total larvae	Larvae of third and later instars	Total larvae	Larvae of third and later instars
1	26	8	23	17
2	12	1	38	19
3	25	15	55	28
Total	63	24	116	64
Ratio	0.381		0.552	

[1] Data taken from a sample of 100 representative plants in each plot.